NATIONAL ENVIRONMENT SERVICE
TU'ANGA TAPOROPORO
COOK ISLANDS

UNGA SURVEY 2016

Mangaia
Cook Islands

COOK ISLANDS
R2R
RIDGE TO REEF

CONTENTS

Acknowledgements 5
Introduction 6
Survey Sites 8
Survey Method 8
- Preparing Bait Stations
- Surveying of Sites

General Results 10
- Population catch Per unit of effort & size structure
- Sex Ratio
- Hunter's experiences & perceptions

Conclusion & Recommendations 14
Reference 14
- Appendix 1: Survey Participants
- Appendix 2: Coconut crab growth curve & thoracic length to weight relationship
- Appendix 3: Mangaia coconut crab baited survey: summary information and results
- Appendix 4: List of Coconut crab hunters interviewed

Mangaia Unga Survey Participants
Ivirua (above) and Tamarua (below)

ACKNOWLEDGEMENTS

The survey of Unga on the island of Mangaia was made possible with funding from the National Environment Service (NES) – Ridge to Reef (R2R) Project.

We acknowledge the support and contributions of many people and agencies. Our appreciation goes particularly to Mangaia landowners, traditional leaders, church leaders and the Island Council for their support to this survey.

We gratefully acknowledge the contributions of all the participants who willingly gave their time to be part of the survey team.

Our appreciation goes to the Secretariat of the Pacific Community (SPC), in particular Ian Bertram and Franck Magron for the technical assistance with the survey planning and data analysis.

> *Akameitaki'anga takake ki te iti tangata o Auau Enua, te Mayor e toou ruru konitara, te au mema paramani, te au Puna no teia tika'anga kia rave ia teia tare'anga unga e ta kotou turuturu i teia angaanga. Meitaki Ngao.*

Report prepared for Mangaia Island Council and community; by,
Elizabeth Munro, Olaf Rasmussen, Moana Tetauru, Basilio Kaokao
National Environment Service
Date July 2017

INTRODUCTION

Coconut crab (*Birgus latro*) is an important food s ource and is regularly offered at community feasts or family occasions on Mangaia and regularly sent to family members living off island. In 2014, the two Puna (Keia, and Tavaenga) of Oneroa identified the need for the preservation of the coconut crab in their district and declared a Ra'ui on the harvesting of coconut crab, locally called Unga in the boundaries of the two puna.

Mangaia Island consultations held by the National Environment Service - Ridge to Reef Project (NES – R2R) consultation team from the 15th – 19th of August, 2016. During these consultations specific species were protected within the designated Ra'ui areas, including a harvesting/ hunting ban within the boundaries of Puna Tavaenga and Puna Keia (Oneroa village). These consultations identified the lack of current information of the unga numbers and sizes, therefore an assessment was required to fill this knowledge gap on unga. The intentions of the survey will provide the Island with information on population, size structure, sex ratio and distribution to inform and strengthen management practices and decision making and provide comparison of the Unga population within Ra'ui and non- Ra'ui areas.

In 2015, a similar survey was conducted in Mauke with similar methodology for the Mangaia Unga survey. This was conducted from the last quarter to first quarter moon phase of October 2015 with a total of 35 baited stations assessed from 10th to 15th October 2015 and a total of 199 crabs were counted and measured.

The Mangaia coconut crab survey was conducted from the 24th October – 5th November during the last quarter to first quarter moon of October/ November 2016. There were 46 baited stations assessed of which 32 were in coastal areas and 14 in inland areas.

NES led delegation engaged local participants from government and the community as well as two participants from Mauke who were part of the Mauke coconut crab survey where they provided technical support and shared their experience. Technical assistance from Ian Bertram of SPC, assisted with the random setting of the survey sites and the analysis of data once collected.

Unga Feeding

Female Unga

AIM

The aims of this survey were to;

1. Conduct an island wide coconut crab survey. To gather information to understand population distribution and size structure, sex ratio and to provide an indication of relative abundance.

2. Build capacity of the people on Mangaia to be able to monitor coconut crab population on their island in future.

3. Build the capacity of the people on Mangaia to understand the importance of surveys and gathering information to support their management programmes for coconut crab.

4. Generate baseline coconut crab information for Mangaia

5. Interview hunters to gain perception information about coconut crab behaviour.

6. To support Puna management planning for species protection highlighting the importance of biodiversity conservation and how essential local knowledge is to generate information on protected areas

Participant Training - Mangaia

PARTICIPANT TRAINING

Training of participants was conducted to give the Mangaian participants an understanding of the importance of the application and consistency of the survey methodology. Survey participants were both experienced and new / young hunters who had a good understanding of the layout of the island.

The training commenced with an introduction of the biology of coconut crabs, coconut crab life cycle. This was followed by the survey method to be carried out. This was based around the field application, what will be involved during the survey, and correct use of equipment, identification of species, sex, measuring techniques and recording data.

Participants were taken through hands on training of measuring coconut crabs using callipers also through 20 meter pacing. The pacing is to show participants the 20 meter distance that will be applied when laying baits in the field. Some participants were also trained on the use of the Geographic Positioning System (GPS) and the type of information needed for the field survey.

SURVEY SITES

A total of 46 sites were selected semi randomly and stratified, 32 within coastal and 14 with inland areas (Table 1 and Fig 1). These were placed into habitat classification that was determined by satellite imagery of the terrestrial environment change and approximate distance from coastline as well as within rau'i and non-rau'i areas.

Village	Puna (District)	Stations
Oneroa	Keia	6 I, 7I, 5 C, 6C, 7C, 8C, 9C, 10C
Oneroa	Tavaenga	8I, 9I, 11C, 12C, 13C, 14C, 15C, 16C
Oneroa	Veitatei	3I, 4I, 5I, 2C, 3C, 4C
Ivirua	Ivirua	11I, 13I, 19C, 20C, 21C, 22C, 23C, 24C
Ivirua	Karanga	10I, 12I, 17C, 18C
Tamarua	Tamarua	1I, 2I, 4I, 14I, 1C,25C, 26C, 27C, 28C, 29C, 30C, 31C, 32C

Table 1: Bait station site distribution within 6 Puna (District) on Mangaia.

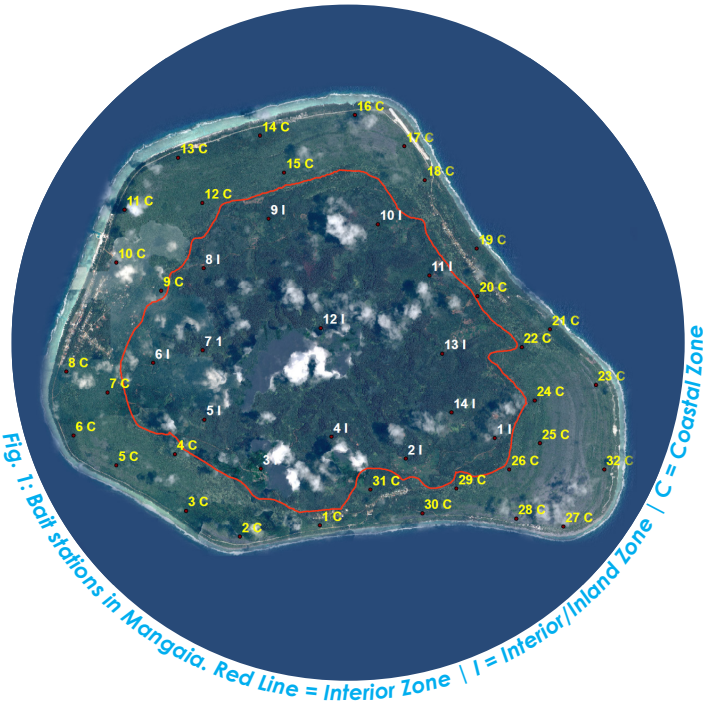


Fig. 1: Bait stations in Mangaia. Red Line = Interior Zone | I = Interior/Inland Zone | C = Coastal Zone

Fig. 2: Bait station sample.

SURVEY METHOD

Participants were assigned into groups which included a local resident from that area (district) to assist with getting close to the survey sites. At each site ten halved coconuts were secured at 20m apart along a trail (Fig 2 and 4). Later in the evening each survey team would return to these sites to search for and record coconut crabs and some sites were resurveyed without laying of baits.

PREPARING BAIT STATIONS

- Each site had 10 halved coconut bait stations.
- Unhusked coconuts were split in half and these half coconuts were placed on bait trail at least 20 meters apart. These baits were secured to strong roots or limestone coral.
- Brightly coloured ribbons were tied to nearby branches or tree trunks/branches to assist in relocating baits at night.
- Each bait station was numbered and GPS coordinates recorded (Fig 4).

Fig. 3: Measuring thoracic length | Photo: Helagi et al. (2015)

SURVEYING OF SITES

- Around an hour after sunset the survey teams returned to baited sites to conduct the survey. The surveys were carried out at 7pm and no later than 9pm.
- Coconut crabs found were captured, measured from the entry point of each site and exit point. Crabs encountered five meters either side of the baited trail were measured, its sex determined and recorded on a data sheet. The length measured and recorded was thoracic length. (Fig. 3)
- Data collected and recorded Coconut crabs encountered were captured as well as thoracic length were measured with callipers to the nearest millimeter. The sex of the crab were determined and female crabs were determined by whether they were carrying eggs.
- Other data were also recorded such as the vegetation type at each site and whether the baits had been eaten by other animals (e.g. rats, goats or pigs).
- All survey data are collected and entered into an excel spreadsheet while the GPS coordinate data are converted into GIS formats to produce spatial data for storage (Figure 5 and 6).

Fig. 4: Recording Bait Station Data

Date	1/10/2016	
Site Number	1 C	
Site Name		
Recorder	Basilio Kaokao	
Baits	10	
GPS WPT #	17, 18, 19	GPS 1
TL (mm)	Sex (M/F	Egg (Y/N)
42	m	
19	f	N
18	f	Y
23	m	
36	m	
11	f	Y
saw 2 in tree, we did not measure		
One bait taken by Pig		
found 3 when we walkd back to truck		
17	m	
21	f	Y
13	f	N

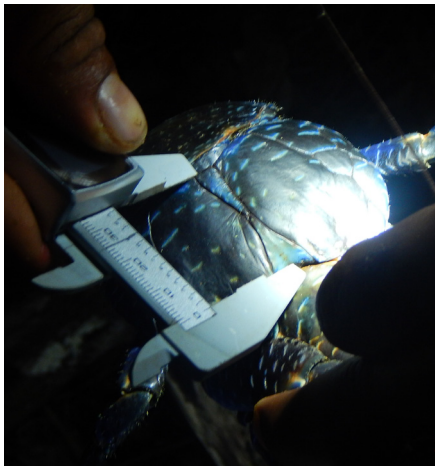
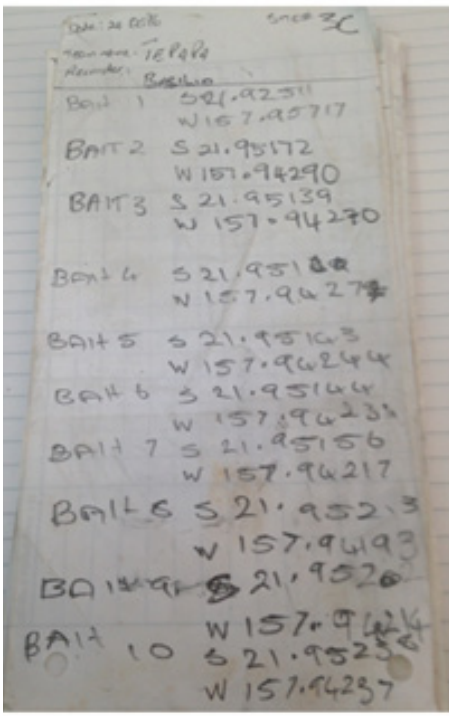


Fig. 5: Data recording sheet and measuring of Thoracic Length.



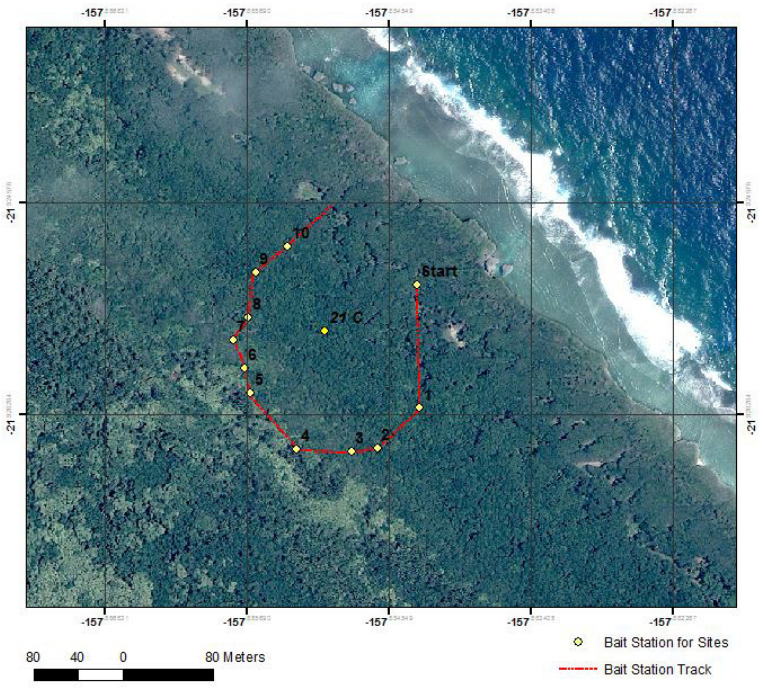


Fig. 6: Example of Bait coordinates and mapped track of survey transects.

GENERAL RESULTS

The 46 survey stations were spread throughout the Island with two focused areas, coastal and inland regions, and within these regions survey stations were distributed within and outside of rau'i Table 1. All stations were surveyed within 6 days (24th October to 1st November), by 3 survey teams.

The surveyors spent time in each of the three villages of Mangaia (Oneroa, Tamarua and Ivirua) where local hunters were interviewed of their method of hunting as well as their perceptions of coconut crabs. Their names and contribution is also captured in this report.

The capacity building provided the participants an understanding of the importance of the survey for data analysis where data collected was consistent.

This is the first coconut crab survey in Mangaia that we are aware of, therefore we had no historical information to compare results, and we therefore used Mauke 2015 (Matamaki et al 2016) coconut crab result to compare with the results of this survey.

POPULATION CATCH PER UNIT OF EFFORT & SIZE STRUCTURE

Catch per unit of effort (CPUE) is used as an indirect way of assessing coconut crab abundance in this survey. CPUE is defined as the number of crabs caught per bait station as a proportion of the number of baits set.

A total, 98 crabs were recorded at 24 of the 46 bait stations. No crabs were recorded in the interior region (stations 1I to 14I) or at stations 4C, 7C, 9C, 10C, 15C and 31C in the coastal region. Seven crabs were found on coastal region baited stations, either in trees, holes in makatea, or on rocky cliffs and could not be captured for taking measurements and sex identification. These records were used to calculate CPUE. Forty crabs were found either on the way to, or returning from bait stations, these records were not used for CPUE estimates, however they were included in population size structure and sex ratio estimates. The reason for not using these record in CPUE estimates was because they were found outside of the baited tail area.

For the coastal region the CPUE (crabs per bait) averaged 0.33 (±0.08), with 0.29 (±0.09) for the rau'i and 0.36 (±0.12) for the non-rau'i areas (Table 2). The average CPUE for all stations (coastal and interior surveyed in Mangaia was 0.23 (±0.06) (Table 2, Fig 7 and Appendix 3). Our results were similar to that in the Mauke unga assessment (Matamaki et al 2016). CPUE were lower in rau'i areas when compared to non-rau'i areas (Table 2). No crabs were recorded in the interior region in both Mauke and Mangaia assessments, despite anecdotal information, that crabs are found in interior regions. In Niue a coconut crab was recorded 5km inland from the coastline (Helagi et al 2015). We postulate that we had insufficient survey coverage in the interior region or a portion of the crab population may still be underground moulting?. Prior the survey and Mangaia, the island had experienced a prolonged dry spell and this may have had an impact on coconut crab density or roaming behaviour.

All CPUE's (excluding interior region) in Mangaia were slightly lower than Mauke but not significantly different.

Region/ Habitat	Mauke		Mangaia	
	AVG. CPUE	SE	AVG. CPUE	SE
All stations	0.39	0.09	0.23	0.06
Interior	0.00	0.00	0.00	0.00
Coastal	0.43	0.09	0.33	0.08
Rau'i Coastal Zone	0.32	0.08	0.29	0.09
Non-Rau'i Coastal Zone	0.46	0.11	0.36	0.12

Table 2: Summary of coconut crab CPUE by regions and zones in Mangaia (2016) and Mauke (2015)

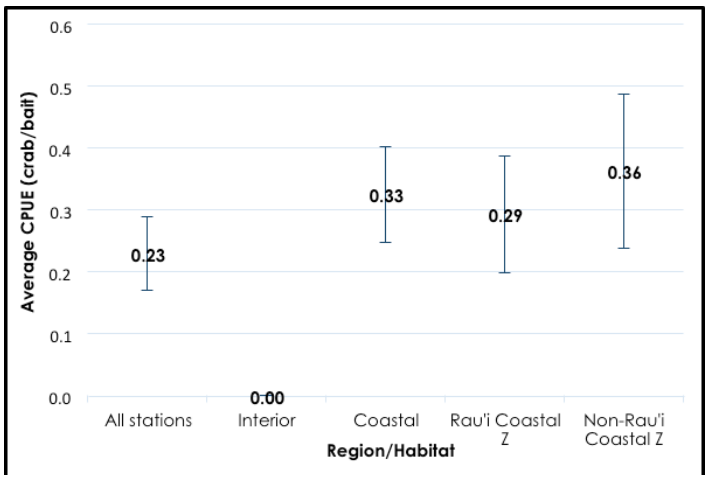


Fig. 7: Average CPUE for all stations surveyed (i.e. aggregated) and by interior, coastal regions, rau'i and non-rau'i zones.

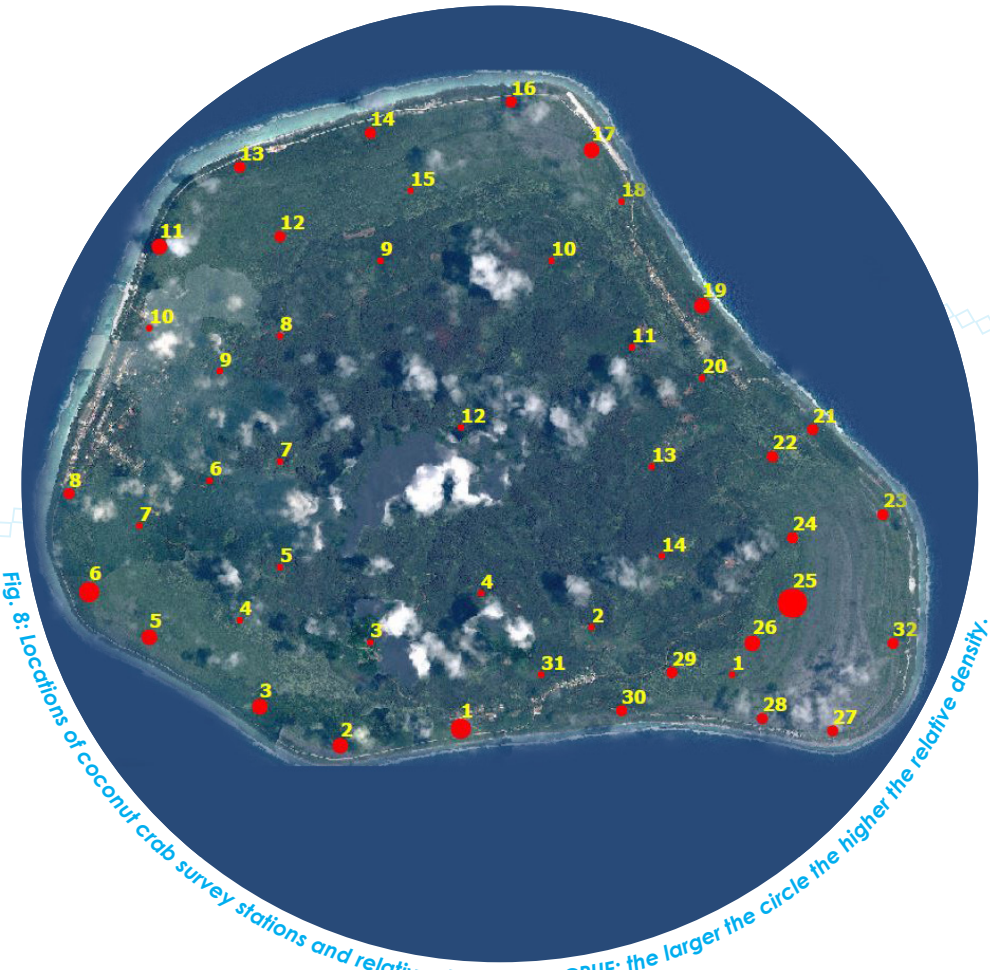


Fig. 8: Locations of coconut crab survey stations and relative densities as CPUE; the larger the circle the higher the relative density.

The crab population size structure in Mangaia is similar to other studies including Mauke and Niue, displaying differences in the size distribution for female and male crabs. The average and maximum sizes of females were smaller than for males (Table 3). In this study, the average size of female coconut crabs is 32 ± 0.83 mm, which is 10% smaller than males at 36 ± 1.16 mm. Similarly in Mauke, the mean size of female coconut crabs was 15% less than male crabs (Matamaki et al 2016). Over 85% and 91% of female and male crabs recorded in the Mangaia assessment were greater than 25 mm, the reported size at maturity (Table 3).

The maximum thoracic length of males were 61mm with an estimated age of around 25 years. The maximum thoracic length for females was 49mm with an estimated age of over 40 years (refer to Appendix 3 for graphical representation of growth curve). Table 3 provides a summary of size information (TL in mm) for female and male coconut crabs recorded during the assessment in Mangaia, compared with a Mauke coconut crab survey.

Statistics	Mangaia 2016		Mauke 2015	
	Female	Male	Female	Male
Sample size	59	79	62	137
Smallest measured (mm)	16	19	13	12
Largest measured (mm)	49	61	42	63
Average size (mm)	32	36	30	35
SE of average	0.83	1.16	0.6	0.9
Proportion > 25 mm*	85%	91%	92%	88%
Proportion > 50 mm**	0%	15%	0%	13%

Table 3: Mangaia vs. Mauke Crab Population Size Structure
** Reported size at reproductive maturity*
*** proposed minimum harvest size.*

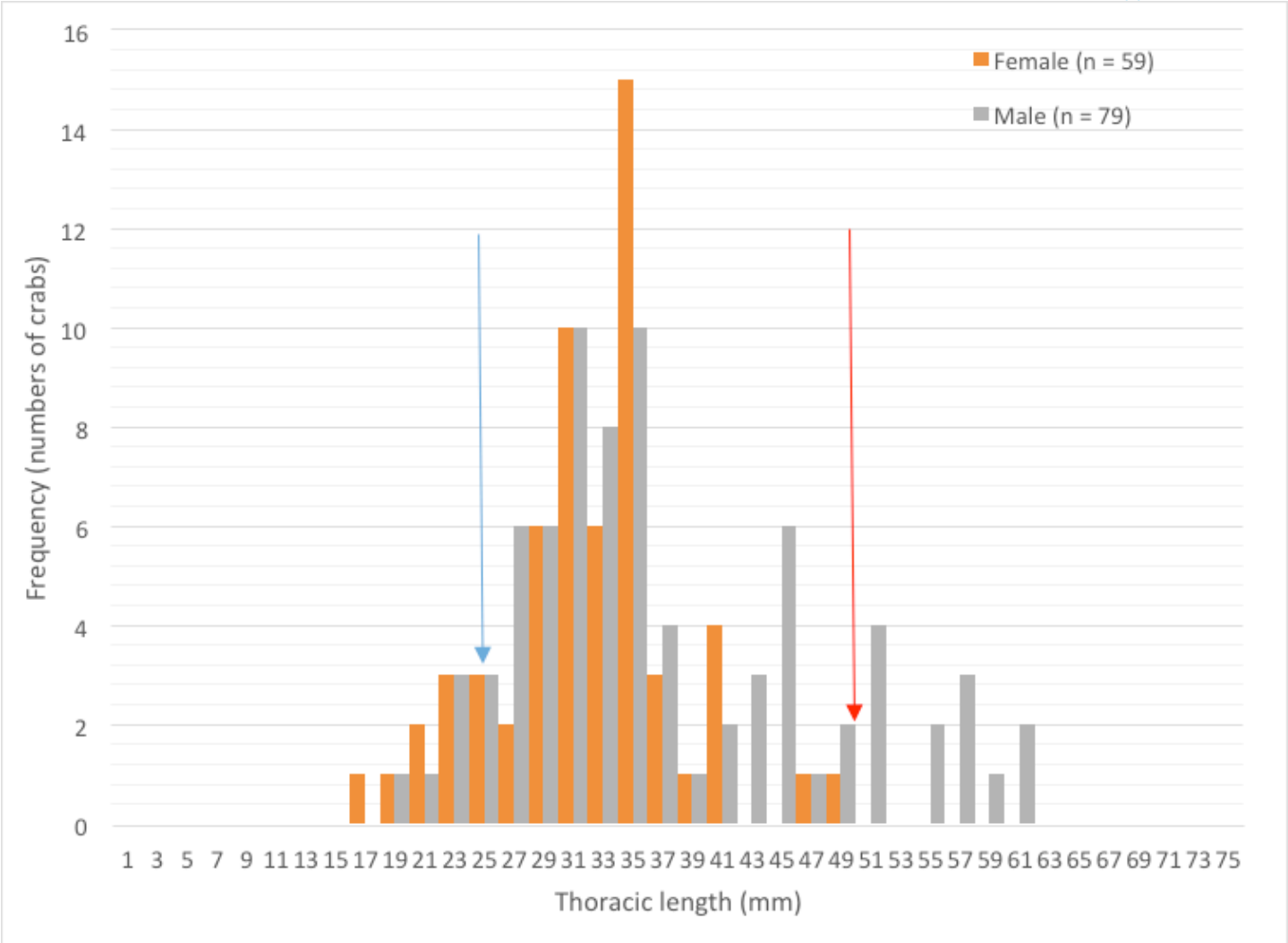


Fig. 8 Thoracic length frequency distribution of male and female crabs recorded at all baited stations in Mangaia. Also illustrated is size at maturity of 25 mm (TL) reported in the literature (blue arrow) and proposed minimum harvest size of 50 mm TL; see below (red arrow).

SEX RATIO

Of the 138 coconut crabs measured during the assessment 59 (43%) were female and 79 (57%) were male. The coconut crab stock in Mangaia is dominated by larger male crabs, 80% of all crabs recorded over 40mm TL were male. In Mauke the male to female ratio is around one male to one female at 23 mm (TL), and diminished rapidly with increasing size in favour of males (Table 4). However in Mangaia the sex ratio for crabs between 21 to 41 mm (TL) was similar (Table 4).

During the survey assessment, none of the females had signs of recent mating and none were carrying eggs, indicating that the survey took place prior to the breeding season.

Mangaia Sex Ratio		
Size TL (mm)	Female	Male
23	1	1
25	1	1
27	1	1
29	1	3
31	1	1
33	1	1.5
35	1	0.5
37	1	1
39	1	1
41	1	0.5

Mauke Sex Ratio		
Size TL (mm)	Female	Male
23	1	1
25	1	1
27	1	1
29	1	1
31	1	2
33	1	2
35	1	3
37	1	4
39	1	4
41	1	5

Table 4. Sex ratio (female to male) by size of coconut crabs in Mangaia and compared with Mauke

HUNTER'S EXPERIENCES & PERCEPTIONS

From the 24th Oct – 5th November 2016, a hunter's perception survey was carried out on the island of Mangaia by National Environment Service Media & Outreach officer, Moana Tetauru. Throughout this time, questionnaires were carried out by those who hunt on a regular basis and those who don't.

In this 2-week period, a lot was learnt about the crab's behaviour and hunter's traditional methods. Of the 10 hunters surveyed, one particular hunter was 64-years of age and had been hunting since the age of four with his father and his grand-father (Appendix 4).

All hunters' experienced high number of crabs caught 20 to 30 years ago compared to the last 5-10 years. During that period, hunters would hunt in pairs or up to four people and caught up to 40 crabs per trip and a busy week would be three nights hunting. Hunters claimed that in the last 5-10 years, the numbers of crabs caught had declined significantly. This is due to a number of factors experienced by the hunters and include; numerous wild pigs, extended periods of dry conditions and a large number of undersized crabs are being taken for home consumption, sent family overseas and for sale.

Of the 10 hunters surveyed, four would hunt up to four times a week with an average catch of around four crabs per hunt.

In terms of the hunting methods, the majority of hunters use traditional methods/practices such as moon phase and tides, and all 10 hunters interviewed remarked that timing is/was evident for a successful catch. The majority would hunt for up to 4-hours between 10pm – 2am, claiming that during these hours the crabs would be 'out and about', and up to 15 baits would be laid and checked three to four days after being laid. The reason for this is that once the bait is set, the baits are left to 'spoil/smell' which draws the crabs closer.

As for the equipment/tools used for hunting, all hunters said while out hunting are torches, machete and sack would be the main tools they would carry with one hunter saying tyre tube or bark of wild hibiscus plant to tie the crab.

Another interesting observation by hunters was that the crabs migrated to the foreshore to release its eggs. All 10 hunters said that crabs that lived inland released their eggs in nearby water holes, and crabs that live along the coastal areas release its eggs into the sea. The theory that all crabs moving towards the coast to release eggs was widely debated during interviews with hunters. The most experienced and oldest hunter was adamant that only coastal crabs release their eggs in the fresh water as he said he had witnessed this.

Hunters claimed that there is a difference in taste when eating the crabs, crabs caught amongst *Pandanus* trees are much sweeter compared to those who live around and feed on dense *Barringtonia* areas.

Of the 10 hunters interviewed, only one female hunter (Appendix 4) was identified in the village of Tamarua. She is currently the Member of Parliament for Tamarua and had been hunting on a regular basis with her husband. During her hunts she would lay up to 50 baits and would catch over 40 crabs a week which she considers a good catch and a reasonable catch was between 15-20 crabs per week.

Only 2 woman hunters were identified by the island and community with Matapo being one of the other woman hunter residing on Rarotonga. In terms of the access ways to each hunting ground, Matapo says this is made easier as they can now drive to the sites, but in terms of hunting she says she noticed a decline in the number of crabs compared to previous years because the crabs are being used to generate income for hunters.

A couple of those interviewed mentioned that a strange odour released by the male crabs is an indication that crabs are abundant in the area.

Hunters mentioned that when crabs go underground, a hunter would look for freshly dug up soil then taps the ground and its surrounding area, when the tapping sound changes from compact to a hollow sound then s/he knows that a crab is present and begins to dig it up.

Another hunter looks and hunts in a specific vegetation habitat, he believes the thicker the vegetation the better. However the only downfall of this, is the time spent walking to the site which he says can take up to one to two hours.

The youngest of the hunters was a 17-year old from Oneroa, who says he had been hunting with his father from a young age and since then has learnt a lot in terms of traditional hunting. With the unga survey conducted on the island, he now understands the importance of over-harvesting and like all hunters would like to see a Rau'i placed in certain areas to allow rejuvenation of crab populations.

CONCLUSION & RECOMMENDATIONS

Due to slow growth rates and relative ease of capture, coconut crab populations can be exploited faster than they can be naturally replenished. From the results of this assessment, the Mangaia coconut crab population requires further management attention.

The Mangaia community has established unga raui area which comprise 31% of the terrestrial habitat. This initiative by the community is commended, and indicates that the community is very conscious of the environment and natural resources. Here we provide additional management options the community could discuss and either implement or not.

1. Control predators. The coconut crab is an important food resource for the community, and uncontrolled predation by feral pigs causes additional mortality to crabs. The feral pig population should be reduced or eliminated by regular culling programmes. This could be supported by the National Environment Service; alternatively, responsible persons could be hired to cull/control the feral pigs.

2.a. Introduce a minimum harvest size limit of 50 mm TL. This management measure allows crabs a better chance to increase in size and contribute to reproductive output before capture. The larger a female crab, the greater the number of eggs produced. A minimum size of 50 mm would effectively protect 100% of the female population and 85% of the male population from harvest. Having a greater number of larger females in the population contributes significantly to reproductive output and subsequent recruitment, thus building the Mangaia stock to a healthy self-replenishing state. When discussing minimum size, we advise managers to have actual crabs of the proposed minimum size on display. It is also recommended that hunters be encouraged to carry measuring instruments during crab hunting trips or

2.b. Ban the harvest of female crabs and introduce a minimum harvest size for male crabs of 45 mm TL. Having a greater number of larger females in the population contributes significantly to reproductive output and subsequent recruitment, thus building the Mangaia stock to a healthy self-replenishing state.

3. Establish a seasonal closure (rau'i) when crabs are reproductively active to ensure coconut crabs, particularly females, are protected during the time of greatest reproductive activity. This allows coconut crabs to mate, brood and release eggs undisturbed, and ensures that as many healthy eggs as possible are released to increase the chances of new recruits coming back to the Mangaia. The public needs to be informed of the closed season. We recommend October to March.

4. Ban or control coconut crab exports. Exports of coconut crabs contribute significantly to harvest pressure and should be controlled or banned. Banning exports would help reduce hunting pressure and rebuild stocks so that larger crabs become more common, thus contributing significantly to reproductive output. Manihiki successfully implement a ban on exports of coconut crabs.

5. Improve public education and awareness about coconut crab biology, life cycle, vulnerability, stock status and unsustainable and sustainable exploitation practices. These education and awareness programmes should also explain why certain management approaches are required and how these approaches benefit the community. A well-informed public is more likely to accept appropriate resource management approaches and be more willing to comply with management measures. Education and awareness should be targeted at various levels (children and adults) and can be in various forms (e.g. posters, pamphlets, videos, radio).

REFERENCE

Helagi, N., Tafatu, J., Bertram, I., Moore, B., Linawick, M., and Pakoa, K., 2015. Status of the coconut crab Brigus latro in Niue. Noumea, New Caledonia: Pacific Community.48pp.

Matamaki, T., Munro, E., Helagi, H., Bertram, I., And Samuel, R., 2016. Assessment of the coconut crab (Brigus latro) in Mauke, Cook Islands. Noumea, New Caledonia: Pacific Community. 22pp.

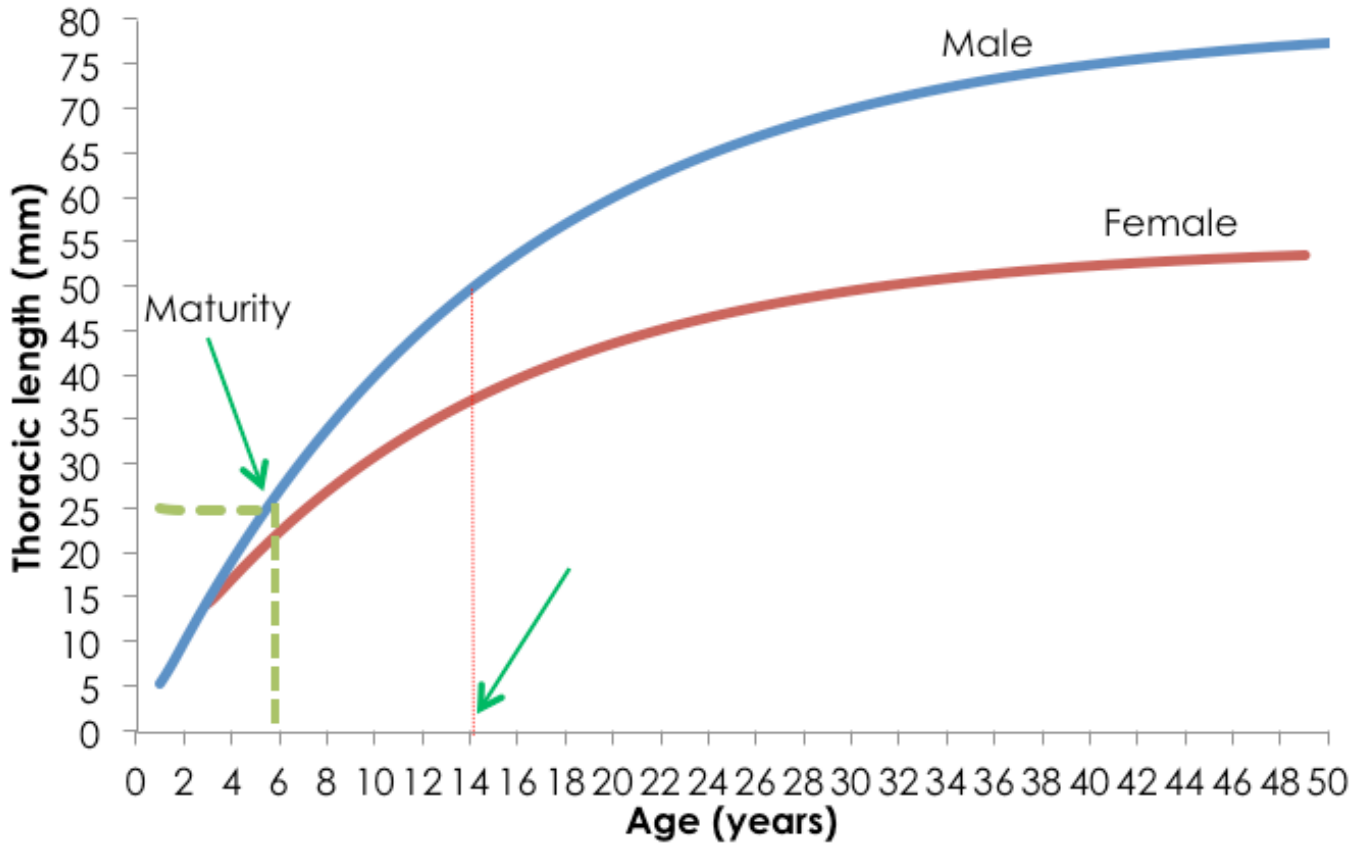
Fletcher, W.J., Brown, I.W., Fielder, D.R. and Obed, A. 1991. Moulting and growth characteristics. In: Brown, I.W and Fielder, D.R. (eds), The coconut crab: Aspects of the biology and ecology of Birgus latro in the Republic of Vanuatu. ACIAR Monograph No. 8.

APPENDIX 1: SURVEY PARTICIPANTS

Participants List	Organisation/Island
Elizabeth Munro	National Environment Services - Rarotonga
Dan- Olaf Rasmussen	National Environment Services - Rarotonga
Moana Tetauru	National Environment Services - Rarotonga
Basilio Kaokao	National Environment Services - Mauke
Tutavake Akamoeau	Mauke
Taokia Taokia	Mangaia
Tama Koroa	Mangaia
Daniel Taokia	Mangaia
Jameson Moekapiti	Mangaia
Maara Ruatoe	Mangaia
Norman Ngere	Mangaia

Participants List	Organisation/Island
Ngatamaroa Pekepo	Mangaia
Rennie Maki	Mangaia
Oki Karena	Mangaia
Tearoa Maine	Mangaia
Matthew Ngere	Mangaia
Terence Ngametua	Mangaia
Kauvarevai Rere	Mangaia
Christian Tangimataiti	Mangaia
Aerenga Matapo	Mangaia
Tuainekore Ngarua	Mangaia
Moeraynga Atingakau	Mangaia
Terepai Ruatoe	Mangaia
Jayden Moekapiti	Mangaia
Faith Taokia	Mangaia
Desiree Harry	Mangaia
Tangimama Harry	Mangaia

APPENDIX 2: COCONUT CRAB GROWTH CURVE & THORACIC LENGTH TO WEIGHT RELATIONSHIP



APPENDIX 3: MANGAIA COCONUT CRAB BAITED SURVEY: SUMMARY INFORMATION AND RESULTS

Village	Puna (district)	Station #	Latitude	Longitude	Region	Management	Number of baits	Crabs observed	CPUE
Tamarua	Tamarua	1	-21.9554	-157.91999	C	NR	10	10	1
Oneroa	Veitatei	2	-21.95709	-157.932	C	R	10	4	0.4
Oneroa	Veitatei	3	-21.95319	-157.94	C	R	10	5	0.5
Oneroa	Veitatei	4	-21.94459	-157.942	C	R	10	0	0
Oneroa	Keia	5	-21.9463	-157.951	C	R	10	4	0.4
Oneroa	Keia	6	-21.94179	-157.957	C	R	10	14	1.4
Oneroa	Keia	7	-21.93519	-157.95199	C	R	10	0	0
Oneroa	Keia	8	-21.93199	-157.95899	C	R	10	2	0.2
Oneroa	Keia	9	-21.91979	-157.944	C	R	9	0	0
Oneroa	Keia	10	-21.9155	-157.951	C	R	10	0	0
Oneroa	Tavaenga	11	-21.9074	-157.94999	C	R	10	6	0.6
Oneroa	Tavaenga	12	-21.9064	-157.938	C	R	10	3	0.3
Oneroa	Tavaenga	13	-21.89949	-157.942	C	R	10	3	0.3
Oneroa	Tavaenga	14	-21.89609	-157.929	C	R	10	1	0.1
Oneroa	Tavaenga	15	-21.9018	-157.925	C	R	10	0	0
Oneroa	Tavaenga	16	-21.89299	-157.91499	C	R	10	2	0.2
Ivirua	Karanga	17	-21.8978	-157.90699	C	NR	10	4	0.4
Ivirua	Karanga	18	-21.9029	-157.904	C	NR	10	0	0
Ivirua	Ivirua	19	-21.91329	-157.89599	C	NR	9	5	0.56
Ivirua	Ivirua	20	-21.92049	-157.89599	C	NR	10	0	0
Ivirua	Ivirua	21	-21.9256	-157.88499	C	NR	10	1	0.1
Ivirua	Ivirua	22	-21.9283	-157.889	C	NR	8	1	0.13
Ivirua	Ivirua	23	-21.93409	-157.878	C	NR	10	2	0.2
Ivirua	Ivirua	24	-21.93639	-157.88699	C	NR	10	2	0.2
Tamarua	Tamarua	25	-21.94289	-157.88699	C	NR	10	21	2.1
Tamarua	Tamarua	26	-21.94689	-157.891	C	NR	10	5	0.5
Tamarua	Tamarua	27	-21.9556	-157.88299	C	NR	10	2	0.2
Tamarua	Tamarua	28	-21.95439	-157.88999	C	NR	10	3	0.3
Tamarua	Tamarua	29	-21.9498	-157.899	C	NR	10	2	0.2
Tamarua	Tamarua	30	-21.95359	-157.904	C	NR	10	1	0.1
Tamarua	Tamarua	31	-21.95	-157.912	C	NR	4	0	0

Village	Puna (district)	Station #	Latitude	Longitude	Region	Management	Number of baits	Crabs observed	CPUE
Tamarua	Tamarua	32	-21.94689	-157.87699	C	NR	10	2	0.2
Tamarua	Tamarua	1	-21.95	-157.893	C	NR	9	0	0
Tamarua	Tamarua	2	-21.94529	-157.90699	I	NR	10	0	0
Oneroa	Veitatei	3	-21.9468	-157.929	I	R	10	0	0
Oneroa	Veitatei	4	-21.9419	-157.91799	I	R	10	0	0
Oneroa	Veitatei	5	-21.9393	-157.938	I	R	7	0	0
Oneroa	Keia	6	-21.9307	-157.945	I	R	10	0	0
Oneroa	Keia	7	-21.9288	-157.938	I	R	10	0	0
Oneroa	Tavaenga	8	-21.91629	-157.938	I	R	10	0	0
Oneroa	Tavaenga	9	-21.9088	-157.92799	I	R	9	0	0
Ivirua	Karanga	10	-21.9088	-157.91099	I	NR	10	0	0
Ivirua	Ivirua	11	-21.9174	-157.90299	I	NR	10	0	0
Ivirua	Karanga	12	-21.92539	-157.91999	I	NR	10	0	0
Ivirua	Ivirua	13	-21.9293	-157.901	I	NR	10	0	0
Tamarua	Tamarua	14	-21.93819	-157.89999	I	NR	10	0	0

C = coastal region, I = internal region, R = Rau'i, NR = Non-rau'i, CPUE = catch per unit effort.

APPENDIX 4: LIST OF COCONUT CRAB HUNTERS INTERVIEWED

Interviewee:	Puna:	Interview by:
Aerenga Matapo	Tamarua	Moana Tetauru (NES Media and outreach officer)
Daniel Taokia	Tavaenga	Moana Tetauru
Kauvarevai Rere	Tamarua	Moana Tetauru
Ngametua Toko	Ivirua	Moana Tetauru
Ngatamaroa Pekepo	Keia	Moana Tetauru
Oki Karena	Ivirua	Moana Tetauru
Rennie Maki	Ivirua	Moana Tetauru
Tama Koroa	Veitatei	Moana Tetauru
Taokia Taokia	Tavaenga	Moana Tetauru
Tetangi Matapo	Tamarua	Moana Tetauru